20. (Once amended) A method as defined in Claim 17 wherein the torque applied with respect to said second axis of said rotor is related to the torque applied with respect to said first axis of said rotor by

$$Ks/(s + 2\pi k f_{nut})$$

where f_{nut} is a [the] nutation frequency of said rotor.

REMARKS

Claims 2, 14 and 18 have been cancelled without prejudice. Claims 1, 3, 4, 8 through 10, 13, 15, 17, 19 and 20 are amended. Thus, by this Amendment, Claims 1, 3 through 13, 15 through 17 and 18 through 20, as amended, are presented for examination.

The Examiner rejected all claims of the application as filed. Claims 1 through 3, 5, 7 through 9, 11, 13, 14, and 17 through 19 were rejected as allegedly anticipated by the United States patent of Paquet et al. While Claims 4, 6, 10, 12, 15, 16 and 20 were rejected as allegedly rendered obvious by Paquet et al. in view of the United States patent of Hoffman et al. In view of the amendments made to the claims and the remarks that follow it shall become apparent that the pending rejections are now inapplicable.

The language of the claims has been amended to

clarify the precise nature of this invention. In particular, the invention is directed to a method and apparatus that permits one to slew a device within a two axis system having a two axis gyro fixed thereto to obtain linear oscillatory slewing motion. As illustrated in Figure 3 of the application, the claimed invention teaches that this is obtained by driving one axis of the gyro with an oscillatory input (slewing) signal (i_{32} or i_{34}) and, at the same time, driving the other axis, through a cross-axis circuit 64 or 66 with the derivative of the input slewing signal. As explained in the application, such slewing of a gyro (and attached device) whose axes of movement are aligned with the gimbal axes will result in undesired coning motion due to the inertia of the gyro rotor.

The invention relies upon the well-known rotor dynamics of a two axis gyro. For this reason, one would expect to find similarities in analysis and operation between the claimed invention and an "Analog Rebalance Loop For a Tuned Rotor Gyroscope" such as that taught by Paquet et al. or a "Three Axis Gyro" as taught by Hoffman et al. However, neither of such patents teaches or suggests the Applicant's claimed invention which is directed to and teaches an entirely different application of the well-known dynamic relationships.

Paquet et al. teaches a rebalance loop for a closed

loop two degree-of-freedom gyro. Pickoff signals xpo and ypo are generated by the sensing of a rate input and applied to cross-axis circuits 72 and 74 and direct axis circuits 76 and 78. In the rebalance loop of Paquet et al. the direct-axis circuit 76 receives xpo and produces a first amplified error signal while the direct-axis circuit 78 receives ypo and produces a second amplified error signal. The cross-axis circuit 72 amplifies xpo and producing a first correction signal while the cross-axis circuit amplifies ypo and produces a second correction signal. The first correction signal is combined with the second amplified error signal at a summing junction 84 to provide the signal for torquing the gyro rotor about one axis while the second correction signal is combined with the first amplified error signal at a summing junction 86 to provide the signal for torquing the rotor about the transverse axis.

Paquet et al. is thus directed to a rebalance loop that enhances the accuracy of measurement of a closed-loop gyro. That is, referring to Figure 2 of that patent, Paquet et al. is directed to improving the accuracy of measurement of $\omega_c x$ and $\omega_c y$ by employing cross-coupling of inputs in a rebalance loop to correct for precession-related factors. While precession plays a role in generating undesirable coning when one attempts to slew a two-axis gyro, the partial overlap of Paquet et al. with the claimed invention only reflects the fact that each is directed to

an improvement in the same device, namely a two-axis gyro. Paquet et al. makes no reference to the slewing of a gyro nor to the problems associated therewith. Paquet et al. employs cross-axis signals to make a correction for precession effects within the feedback loops for driving torquers. Paquet et al. is directed to enhancing the accuracy of measurement by introducing cross-axis corrections.

In contrast, Applicant's invention is directed not to enhancement of measurement of rate. Rather, it is directed to elimination of the undesired off-axis motion of a rotor, resulting in coning, that otherwise occurs when one slews or scans a rotor back and forth. When such a gyro is mounted to a device, such as a camera, that is moveable in a two-axis system whose axes are aligned with the gyro axes, this will produce coning of the line of sight and is therefore to be avoided.

Such harmful coning is eliminated in Applicant's invention by applying an off-axis signal that generates exactly the torque required to null the undesired cross-axis motion otherwise resulting from the inertia of the rotor. Such off-axis signal is the derivative of the oscillatory input slewing signal applied.

Paquet et al. teaches one to derive an accurate signal

to return a rotor to null with respect to both of its sensitive axes (and therefore teaches apparatus that does not permit rotation of a gyro rotor with respect to either one of its sensitive axes) while the claimed invention teaches one to generate a signal to null undesired motion so that linear rotation of the rotor with respect to one of its sensitive axes can occur without coning. Hoffman et al. again necessarily shares gyro principles and theory with the claimed invention as this is unavoidable. However, as such device relies upon gyro coning to measure rotation about a blind axis. As such, it is entirely unsurprising that Hoffman et al. includes analysis that is somewhat applicable to the underlying theory of the claimed invention. However, Hoffman et al., just a Paquet et al. includes absolutely no insight to solution of the problem of coning-paired slewing to which the present invention is directed.

Claim 1 and the claims that depend therefrom are directed to apparatus for limiting movement of a device in response to an input signal to a predetermined linear path in a two-axis system. Such apparatus includes, among other limitations, "said apparatus comprising at least one cross-axis circuit for receiving said input signal and deriving said second signal as the derivative of said input signal so that said second signal drives said second forcer to precess said rotor with respect to said first axis to substantially cancel an effect of

torque applied by said first forcer with respect to said first axis of said rotor." Such limitation, among others, clearly sets the claimed invention apart from Paquet et al. For the reasons set forth above.

Claim 13 and the claims that depend therefrom are directed to apparatus for substantially nulling coning motion in response to the slewing of a two-axis gyroscope of the type that includes a rotor. Such claims include, among other limitations, "a cross-axis circuit for receiving a slewing input signal and deriving a second signal as the derivative of the slewing input signal so that the second signal drives a second forcer to precess the rotor with respect to a first axis to substantially cancel an effect of torque applied to the rotor with respect to the first axis by the first forcer." Again, the art cited by the Examiner fails to teach or imply such invention.

Finally, Claim 17 and the claims that depend therefrom are directed to a method for nulling a first oscillatory torque applied by a first forcer with respect to a first axis of a spinning gyroscope rotor to precess the rotor with respect to a second, orthogonal axis of the rotor. Such claims include, among other limitations, "said method comprising the step of applying a second torque with respect to said second axis of said rotor, said second torque being the derivative of said first torque, to

precess said rotor with respect to said first axis to substantially cancel an effect of said torque applied to said rotor with respect to said first axis by said first forcer." Again, the prior art fails to teach or imply such a method.

For the foregoing reasons, all presently-pending claims define structures that are neither taught nor rendered obvious by Weiner or any permissible combination of Weiner with any other cited reference. Prompt allowance and issuance of all pending claims are therefore earnestly solicited.

Respectfully submitted,

Elliott N. Kramsky
Registration No. 27,812
Attorney for Applicant

Elliott N. Kramsky, Esq.
LAW OFFICES OF ELLIOTT N. KRAMSKY
5850 Canoga Avenue, Suite 400
Woodland Hills, CA 91367
Ph: (818) 992-5221
Fx: (818) 710-2751